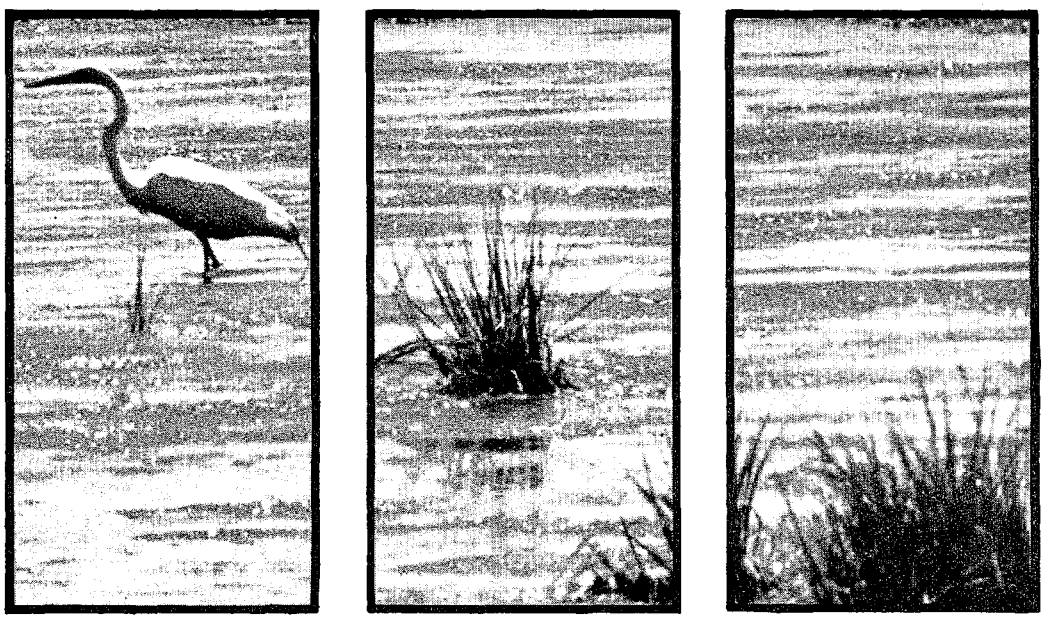

WORKING PAPER NO. 3

PUBLIC INVOLVEMENT

DELAWARE'S COASTAL ZONE MANAGEMENT PROGRAM

GEOGRAPHIC AREAS OF PARTICULAR CONCERN

September, 1976

DELAWARE STATE PLANNING OFFICE
530 South duPont Highway
Dover, Delaware 19901

PREFACE

This is the third in a series of working papers which will be issued to interested citizens and governmental officials so that they may actively and effectively participate in the development of Delaware's Coastal Zone Management Program. The papers will contain the major components of the management program now being developed under the direction of the Delaware State Planning Office. Working papers will be issued on the following six subjects:

1. Program Overview and Public Review Guidelines
2. Coastal Zone Boundaries
3. Geographic Areas of Particular Concern (GAPC's)
4. Permissible Uses
5. Federal-State Interaction and the National Interest
6. Authorities and Organization to Implement Program

This paper will not completely address the Geographical Areas of Particular Concern (GAPC's) issue. It deals only with the process of determining areas and describes the significance of those areas considered and the initial planning steps taken which will lead to eventual designation of Geographic Areas of Particular Concern.

An addendum to this paper will designate areas of particular concern as well as recommended management policies, future needs and actions.

W O R K I N G P A P E R N U M B E R 3

GEOGRAPHIC AREAS OF PARTICULAR CONCERN

Delaware Coastal Zone Management Program

TABLE OF CONTENTS

GEOGRAPHIC AREAS OF PARTICULAR CONCERN (GAPC'S)

INTRODUCTION

A state's coastal zone management program must come to grips with the designation of portions of the coastal area that are of particular concern. The Federal Coastal Zone Management Act of 1972 (Public Law 92-583) requires "an inventory and designation of areas of particular concern within the coastal zone" (Section 3056.3) and that "the management program make provisions for procedures whereby specific areas may be designated for the purpose of preserving or restoring them for their conservation, recreational, ecological, or esthetic values" (Section 306c.9).

The regulations implementing the Act clarify the role of these areas to include:

> "Geographic areas of particular concern are likely to encompass not only the more often cited areas of significant natural value or importance, but also, transitional or intensely developed areas where reclamation, restoration, public access and other actions are especially needed; and those areas especially suited for intensive use or development. In addition, immediacy of need should be a major consideration in determining particular concern." (920.13)

In Delaware's Program these areas have been defined to include areas whose characteristics or impending utilization are of concern to more than just the residents or government of a local area. In many cases the State's concern is derived from its traditional role in preserving the State's natural resources, but in others it reflects the particular responsibility of state government to provide the facilities, services and programs required to serve developed and developing portions of the coastal zone.

This working paper describes the process for determination, the significance of the areas considered and the initial planning steps taken which will lead to designation of Geographic Areas of Particular Concern.

PROCESS OF DETERMINING GEOGRAPHIC AREAS OF PARTICULAR CONCERN

Delaware's coastal zone management activities have traditionally been motivated by growing public concern over the use of or loss of certain State resources, especially its welands and beaches. The Delaware Coastal Zone Act of 1971, the Beach Preservation Act of 1972 and the Wetlands Act of 1973, all reflect heightened concern over specific resources and areas.

Early in Delaware's program development other areas of concern became apparent, largely due to input from members of the Coastal Zone Management Committee, special interest area workshops, and efforts of specific purpose groups such as the Delaware Tomorrow Commission.

During the preparation of the first application for federal program development assistance, a thorough review was made of previous coastal zone studies to ascertain the extent to which certain geographic areas of concern had been identified. Particular emphasis was given to the reports of the Governor's Task Force on Marine and Coastal Affairs and the Governor's Wetlands Action Committee. Additionally, recent State legislation, both enacted and proposed, was reviewed to discern statements of public policy regarding areas of particular concern. From this process emerged many of the categorical areas recommended for designation as areas of particular concern.

Potential areas were also developed from discussion among program staff and the various members of the Coastal Zone Management Committee, the officially designated intergovernmental/interagency technical and coordinating committee for the program. Many of the recommendations were expressed in terms of subjects needing detailed research to document the extent of the resource, the problems surrounding its use, and the reasons for its particular concern. Work in developing better understanding of wetlands and their biological values, coastal erosion processes, groundwater problems and coastal flooding emerged from this process.

An equally important part of the determination process involved the use of small workshops comprised of representatives of special interest groups and organizations. These sessions, called "mini-workshops" were organized into four groups: agriculture, conservation and environment, industry, and recreation and resort development. Participants in each workshop were asked to identify geographic areas of particular concern from their specific viewpoint and to suggest criteria for the evaluation and designation of the areas. From these meetings emerged such recommendations as prime agricultural lands, areas of significant resort/second home development, specific industrial development sites, historic and archaeological sites, and a major list of resource areas which were eventually categorized as "critical natural areas".

These and other recommendations have been examined and described as part of the program development effort. It should be noted that the federal program regulations provide that GAPC's should reflect areas which are of state or regional concern as opposed to strictly local concern. Hence, the areas recommended in this section reflect one or more of the following basic principles:

1. They are of concern to the State due to impacts on State facilities, programs, or plans;

2. Action relative to the use or management of the area is required by more than one unit of local government or

3. The resource or area has recognizable value to broad segments of the general population.

Descriptions of the categories of areas considered and the reasons such areas are considered to be of particular concern follows.

Areas of Unique, Scarce, Fragile or Vulnerable Natural Habitat or Feature, Historic or Archaeological Significance, or Scenic Value

Significance

Natural areas are sometimes described as places passed by man in his struggle to tame the land for his livelihood and recreation. This "escape" can be attributed to a variety of circumstances: often the land was too steep, too rocky or too wet for farming or building. In recent years moreover, public and private land acquisitions have been instrumental in preserving these fast depleting resources.

Natural areas are usually of high aesthetic value--places of beauty. They may include the habitat for rare or endangered plants and animals, or they may be cherished by geologists or archaeologists as irreplaceable evidence of Earth's development and past civilizations.

Here in America, early settlers were faced with survival. They had to conquer the land in order to exist in the wilderness. Existence once secured slowly gave way to further land use changes in the name of progress. Today, this "progress" continues to the extent that we are now in danger of improving nature and ourselves out of existence. Currently, recognition of irretrievable loss is providing growing support for the preservation of remaining critical natural areas.

Natural areas should be known and appreciated, yet too many visitors can often lead to degradation of the area. It will take an understanding public to save remaining natural areas. Understanding, environmental conscience and environmental maturity are the products of comprehensive education. This then is a basic challenge to educators and to Delaware's Coastal Zone Management Program.

Certain portions of the State's coastal zone are of particular concern primarily because they are limited in number, have some special connection to an important event or time in the State's history or culture, are widely recognized for their singular beauty or attractiveness, or represent a resource of great value for educational or scientific research purposes. In many respects these areas represent a "last stand", because once lost there are few if any others of its type, character or condition. In other cases areas may not warrant such dramatic action, but their presence requires a sensitivity to the resource, an awareness of its existence when making coastal zone management decisions.

Initial Planning Steps Taken

As an important first step in critical natural area designation and preservation, the Delaware Nature Education Society has completed a statewide inventory of such areas. Completion date for the first phase, New Castle

County, was June 1975. The Kent and Sussex Counties study was completed in April 1976. Work on the first phase was sponsored by the New Castle County Parks and Recreation Department. The second phase was developed as part of Delaware's Coastal Zone Management Program.

A working definition of the term "natural area" was developed as a study base: "a natural area contains some feature(s) of unique or typical natural occurrence in its situation, type of plant life, animal-plant community, or geological, archaeological, aesthetic features, or combinations thereof". This inventory of outstanding natural areas makes no claims to completeness since it is inevitable that some worthy properties have been overlooked. Also, the selection process involved value judgements, albeit by experts, but subjective nonetheless.

An advisory committee was assembled to assist with the inventory of natural areas. This committee has rendered invaluable service in review, consultation and supply of information. Criteria were developed to provide a basis for on-site judgement of each area. These include: air quality, water quality, noise level, visual appeal, degree of recent or unhealed man-made disturbance, unusualness, rarity, or uniqueness, education potential, research potential.

Field survey by a research team was followed by numerically rating each area. Based upon the numerical rating an index was developed for purposes of assigning a broad priority ranking. Field reconnaissance for each area included tentative boundary determination and, where appropriate, a sampling of vegetation. In most upland areas, vegetative profiles were taken; i.e., all vegetation within a 50-foot radius of an arbitrarily selected site was identified and recorded by species within the proper stratum. Standard forestry measurements, diameter at breast height (dbh) and an estimate of height, were made selectively to aid in estimation of forest age. This information provides an indication of cover and food supply present for animals. Animal signs were noted, but no field investigations into the nature of the faunal community were conducted. Although a great deal is known of fauna in general, there is comparatively little specific information on fauna for the individual natural areas defined. Existing data have been referenced or included as available.

Geological areas named in this inventory fall into two categories. Some are singular or rare examples illustrating ongoing development of land forms or revealing something of Delaware's geologic past. Others which are less rare are exemplary exposures of paleogeologic features and therefore ideal teaching tools.

Techniques for archaeological research have advanced markedly during the past two decades. Since this scientific trend is expected to continue, experts believe that a sample of large proven sites must be reserved for future exploration. Archaeological areas selected are comparatively undisturbed portions of sites known to be productive of exceptionally valuable evidence representing the distinct cultural phases in Delaware's prehistory.

A total of 101 natural areas and 38 scenic vistas were identified in these natural areas studies.

In addition to the above areas, atlases of historic and archaeological sites at a scale of 1"=800' were prepared as a planning and management tool. These atlases are being updated and maintained from records and ongoing survey efforts by the Delaware Division of Historic and Cultural Affairs. The number of these records run into the hundreds and reflect sites, structures, excavated and unexcavated finds, or known locations of historic events. A symbol system has been introduced into the atlas to reflect Historic Registrar designation as well as the different classes of record and area.

Areas of High Productivity or Essential Habitat for Living Resources, or of Critical Concern for the Production of Food

Significance

The coastal zone, both land and waters, is crucial to the life chain of all forms of life, including man. Included are the tidal waters, the near-shore zones, the coastal wetlands, and those coastal lands which posses a high natural productivity for agricultural and horticultural pursuits. Destruction of these areas in any whole scale manner, whether in one major event or as a consequence of multiple smaller actions, ultimately leads to food shortages and higher prices to man, possible elimination of certain species, and unpredictable changes in the ecological balance ranging from nuisance to catastrophy. Hence, concern for these areas involves economic, recreational, quality of life, possibly public health, and certainly ecological issues. Since the areas and the creatures which inhabit them encompass large portions of Delaware's coastal area and are of value to broad segments of the citizenry, they are subjects of considerable State concern.

In at least one resource area this concern has lead directly to legislation, the Delaware Wetlands Act of 1973. In the purposes section of this Act the General Assembly declared that:

> "...much of the wetlands of this State have been lost or despoiled by unregulated dredging, dumping, filling and like activities and that the remaining wetlands of this State are in jeopardy of being lost or despoiled by these and other activities; that such loss or despoliation will adversely affect, if not entirely eliminate, the value of such wetlands as sources of nutrients to finfish, crustacea and shellfish of significant economic value; that such loss or despoliation will destroy such wetlands as habitats for plants and animals of significant economic and ecological value and will eliminate or substantially reduce marine commerce, recreation and aesthetic enjoyment; and that such loss or despoliation will, in most cases, disturb the natural ability of

wetlands to reduce flood damage and adversely affect the public health and welfare; that such loss or despoliation will substantially reduce the capacity of such wetlands to absorb silt and will thus result in the increased silting of channels and harbor areas to the detriment of free navigation. It is hereby determined that the coastal areas of Delaware are the most critical areas for the present and future quality of life in the State and that the preservation of the coastal wetlands is crucial to the protection of the natural environment of these coastal areas..."

The values ascribed to these wetland areas include: production of nutrients for fish production; provision of spawning and nursery areas for many species of finfish and shellfish; provision of habitat for waterfowl and furbearers; flood protection for adjoining uplands and recreational use in their natural state. Particularly critical are the areas in the water and near the shore which are spawning and nursery areas for many species of fish and shellfish. Generally these areas lie within 100 yards of shore, with average depths of 2-3 feet. These areas require particular consideration in Delaware's Coastal Zone Management Program.

Initial Planning Steps Taken

Wetlands as a resource class were defined and mapped as part of the requirements of the Wetlands Act of 1973 and include:

"Wetlands" shall mean those lands above the mean low water elevation including any bank, marsh, swamp, meadow, flat or other low land subject to tidal action in the State of Delaware along the Delaware Bay and Delaware River, Indian River Bay, Rehoboth Bay, Little and Big Assawoman Bays, the coastal inland waterways, or along any inlet, estuary or tributary waterway or any portion thereof, including those areas which are now or in this century have been connected to tidal waters, whose surface is at or below an elevation of two feet above local mean high water, and upon which may grow or is capable of growing any but not necessarily all of the following plants:

Eelgrass (Zostera marina), Widgeon Grass (Ruppia maritima), Sago Pondweed (Potamogeton pectinatus), Salt Marsh Cordgrass (Spartina alterniflora), Salt Marsh Grass (Spartina cynosuroides), Salt Marsh Hay (Spartina patens), Spike Grass (Distichlis spicata), Black Grass (Juncus gerardii), Switch Grass (Panecum virgatum), Three Square Rush (Scirpus americanus), Sea Lavender (Limonium carolinianum), Seaside Goldenrod (Solidago sempervirens), Sea Blete (Suaeda maritima), Sea Blete (Suaeda linearis), Perrennial Glasswort (Salicornia virginica), Dwarf Glasswort (Salicornia bigelovii), Samphire (Salicornia europaea), Marsh Aster (Aster tenuifolius), Salt Marsh Fleabane (Pluchea purpurascens var. succulenta), Mock Bishop's Weed (Ptilimnium capillaceum), Seaside Plantain (Plantago aliganthos), Orach (Atriplex patula var. hastata) March Elder (Iva frutescens var. oraria), Goundsel Bush (Baccharis halmifolia), Bladder Wrach (Fucus vesiculosis), Swamp Rose Mallow, Seaside Hollyhock or Marsh Mallow (Hibiscus palustris), Torrey Rush

(Scirpus torreyi), Narrow-leaved Cattail (Typha angustifolia), and Broad-leaved Cattail (T. latifolia) and those lands not currently used for agricultural purposes containing four hundred (400) acres or more of contiguous non-tidal swamp, bog, muck, or marsh exclusive of narrow stream valleys where freshwater stands most, if not all, of the time due to high water table, which contribute significantly to groundwater recharge, and which would require intensive artificial drainage using equipment such as pumping stations, drain fields or ditches for the production of agricultural crops.

High altitude infrared aerial photography was interpreted to define the wetlands areas and was used to create an official set of wetlands maps. The preparation of a Wetlands and Water Atlas which divides the wetlands into various zones and classes reflecting their species composition, habitat and other characteristics is being developed as part of Delaware's program.

Areas of value for agricultural and horticultural purposes were delineated from a detailed soils interpretation system developed by the U. S. Soil Conservation Service. This was compared with an inventory of currently farmed or cropped lands. The classification system reflects productivity of the soils under both natural conditions and engineering improvement practices, especially drainage or irrigation. Concern for these areas is crucial since many of these soils are located in the coastal zone and subject to intense pressures for urban and recreational development. Following is a list of soils included in this area of particular concern:

High Potential for Agricultural Productivity in Natural State:

SaA	Sassafras sandy loam, 0 to 2% slope
SaB, SaB2	Sassafras sandy loam, 2 to 5% slope and moderately eroded
SfA	Sassafras loam, 0 to 2% slope
SfB	Sassafras loam, 2 to 5% slope
Ka	Kalmia sandy loam
ChA, ChB	Chester loam, 0 to 3% and 3 to 8% slope
CsB2	Collington fine sandy loam, 2 to 5% slope
EaB2	Elivak silt loam, 3 to 8% slope
EnB2	Elsinboro silt loam, 3 to 8% slope
GmB2	Glenelg and Manor loams, 3 tp 8% slope
MeA	Matapeake silt loam, 0 to 2% slope
MeB, MeB2	Matapeake silt loam, 2 to 5% slope
MkA	Matapeake silt loam, silty substratum, 0 to 2% slope

MkB2	Matapeake silt loam, silty substratum, 2 to 5% slope
NmA	Neshaminy and Montatto silt loams, 0 to 3% slope
NmB2	Neshaminy and Montatto silt loams, 3 to 8% slope
TaB2	Talleyville silt loam, 2 to 5% slope
BuA	Butlertown silt loam, 0 to 2% slope
BuB2	Butlertown silt loam, 2 to 5% slope

High Potential for Agricultural Productivity With the Addition of Irrigation:

EvA, Ev	Evesboro loamy sand, clayey or loamy substratum, 0 to 2% slope
EvB	Evesboro loamy sand, loamy substratum, 2 to 5% slope
KbA	Kenansville loamy sand, 0 to 2% slope
KbB	Kenansville loamy sand, 2 to 5% slope
RuA	Rumford loamy sand, 0 to 2% slope
RuB, RuB2	Rumford loamy sand, 2 to 5% slope, moderately eroded

High Potential for Agricultural Productivity With the Addition of Drainage:

Kl	Klej loamy sand
Wo, WoA	Woodstown sandy loam, 0 to 2% slope
WoB2	Woodstown sandy loam, 2 to 5% slope
Ws, WsA	Woodstown loam, 0 to 2% slope
WsB2	Woodstown loam, 2 to 5% slope
Fa	Fallsington sandy loam
Fs	Fallsington loam, 2 to 5% slope
Pm	Pocomoke sandy loam
Mt, MtA	Mattapex silty loam, 0 to 2% slope
MtB2	Mattapex silt loam, 2 to 5% slope

Areas of Substantial Urban Use, Recreation or Economic Value, Opportunity or Concentration

Significance

Portions of Delaware's coast are used for urban activities including housing, resort development, active recreation, industry, navigation, harvesting of marine species, and various forms of commercial enterprise. While statistics are often limited or questionable by which to measure the value of the area for economic uses, the area is heavily used for recreational purposes by residents of Delaware and adjacent states. It has been estimated that over 150,000 people pour into the Atlantic Coast beach areas on a typical summer day. A 1967 census of transportation estimates Delaware's coast to be the destination for over one million person-trips.

Likewise, the Sussex County portion of the State's coast is a highly desired location for both permanent and seasonal housing. In 30 years (1938-1968) 25 percent of Rehoboth Bay, 44 percent of Indian River Bay, and 10 percent of Little Assawoman Bay shorelines have been developed as compared to almost no development prior to 1938. Although slowed somewhat by economic conditions during the 1970's, the trend for such use continues.

The resort industry, reputed to be Delaware's second largest industry (after manufacturing), was estimated in 1972 to have generated almost $38 million in tourist expenditures in just the ocean shore-eastern Sussex County portion of the State. These sales ranged from 20 percent of the total retail trade to almost 100 percent of the combined services (hotel, campgrounds, etc.) in the area studied.[1] The strength of this industry results in significant pressures for use of coastal resources.

The coast, including the State's coastal waters are also heavily used for industry. While little industry is found in the Kent or Sussex County portions, major industries (duPont, Getty Oil, Pheonix Steel, Atlas Chemicals and Amoco Chemicals are examples) have located in the New Castle County portion. Additionally, major undeveloped industrial holdings are found in all three counties, including Shell Oil Company, Union Carbide, and Lukens Steel in New Castle County, a consortium of oil companies in Kent County, and Hercules and Star Enterprises in Sussex. Industry favors these sites due to their water access, large size and relatively low cost.

Marine transportation is also a major activity in the coastal area with over 16 ports and 2 open-bay areas located in the Delaware River from Delaware City to Trenton, New Jersey. These ports handled almost 134 million short tons of cargo in 1968. Undoubtedly the volume is higher now. Pressures continue to surface for a port facility in the lower Delaware Bay and indications are that considerable volumes of traffic can be expected from offshore development if economically exploitable quantities of oil or gas are found.

Finally, the Delaware Bay is a major harvesting area for oysters, other shellfish, and many commercial valuable species of fish. A major portion of the Bay is leased for commercial oyster harvesting. The Bay and Ocean are also favorite sports fishing areas providing seasonally abundant populations of bluefish, flounder, sea bass, sea trout and other species.

The significance of these uses and trends lies in their competition for the same resources and areas, in the public services and facilities necessary to accommodate them, and the impacts of concentrated uses by man on fragile coastal resources. The State is particularly concerned with the public facilities impacts (i.e., roads, water and sewer services, police and health facilities, etc.) and with the pollution and abuse of resources. In both instances, the impacts and the

[1] Robert L. Meinen, unpublished Masters thesis, University of Delaware, 1974 Economic Analysis of Delaware Ocean Shore Zone.

costs of dealing with them transcend the mere concern of local units of government. In most cases it is the State which must build the roads, make major commitments of grants to finance sewer construction, provide for much of the public safety and health services, rebuild beaches damaged by coastal storms, and regulate uses of the coastal waters, including harvesting of marine species, discharge of effluents and placement of structures on the subaqueous lands.

The State is particularly concerned with providing access to the beaches and coastal waters. While the State owns a major portion of the Atlantic Ocean coast and operates the areas as State parks, accesses to other areas are limited. Accordingly, State plans and programs such as the Delaware Statewide Comprehensive Outdoor Recreation Plan (SCORP) and the land acquisition and capital development funds have provided for acquisition and development of a series of boat ramps and access points along the Delaware River and Bay and in the inland bays. In this regard, the 1975 Needs Survey conducted as part of the updating of the SCORP found that "accessibility in the form of additional parking, launching and mooring facilities is needed at the marine areas of Delaware". According to this study "the largest 1975 deficit in water-based recreation facilities was found in boating access". Similar deficiencies exist in regard to fishing and shellfishing facilities.

Partially in response to this need, the State has established a policy of requiring the right of public access and use for all beach/coastal areas which are restored by State erosion control and beach nourishment programs.

Finally, the Outdoor Recreation Plan makes particular reference to shore/coast access in the more urban portions of the State where much of the coast has been or may soon be preempted for non-recreational uses. Both New Castle County and the City of Wilmington currently have specific studies concerning these issues underway.

Initial Planning Steps Taken

Primary determination of the areas of concern in this category came by asking representatives of the industrial and the recreation/resort interest groups to indicate their areas of greatest interest. These designations were compared with past expressions of State concern as reflected in various studies, plans, or reports.

Additionally, a Statewide Land Use Survey (1973) was compared with past surveys and expected areas of development (based on locations of major highways, sewer facilities, and already urbanized areas). Marine harvest areas identifying distributions of various sport and commercial fishes and shellfishes were identified from State lease records and from studies performed as part of the Wetlands and Water Resources Atlas.

Areas Subject to Significant Hazards Due to Coastal Processes

Significance

Delaware's coast is neither predictable nor necessarily docile. In a timeless pattern the land has waged a losing battle to the sea, sometimes in

slow almost inperceptible bites but in others in the savagery of severe coastal storms. These processes result in the damage and frequently the total destruction of buildings, roads and other facilities. In severe cases they threaten life.

Records of this process abound. Erosion at Cape Henlopen has been estimated to average over 10 feet per year along the Atlantic Coast, explaining the destruction of the Cape Henlopen lighthouse in 1926. A 1962 coastal storm caused an estimated $16-22 million in damages (1962 dollars) and took seven lives. A shorter duration storm in 1974 required the evacuation of 800 people and caused damages well in excess of $3 million. Elsewhere along the coast continued beach restoration programs must be undertaken to replace sand eroded away, yet in other areas frequent dredging is necessary to keep harbors and channels free of deposited material and open for navigation.

Because of the constant public cost of restoration and/or dredging, or the threat of loss of life in extreme conditions, or the cost and suffering encountered following severe storm phenomenon, these areas are the subject of considerable State concern.

Initial Planning Steps Taken

Lands falling into this classification reflect two coastal processes: coastal geology (erosion and accretion); and storm damage (coastal flooding potential). Determination of the areas subject to coastal erosion or accretion is made from observation of long-term change to the coastline as evidenced by aerial photography and supplemented by core borings of coastal sediments, observation of coastal areas after severe storm events, and analysis of the State's geologic history. Rates of change, direction of change, and likely trends can be assessed and mapped to delineate areas where erosion, accretion or deposition have and are likely to occur. As part of the Delaware Program, a detailed study was made of the coastal processes affecting the State's shoreline. This information is presented in Technical Report Number 1.

Flood hazard and storm damage zones have been initially delineated by the Federal Flood Insurance Program under the Department of Housing and Urban Development. Additional work assessing actual records of storm damage profiles and storm damage awareness has been done (Technical Report Number 4).

Groundwater Resources Areas

Significance

Groundwater serves as a major source of water supply in Delaware and is the sole source of industrial process, irrigation, and domestic water for about 90% of the land area of the State. It accounts for 59% of all water consumed Statewide and in Kent and Sussex Counties, it supplies 99% of water used.

As development and urbanization of the State intensifies, the potential for pollution of groundwater aquifers (subsurface reservoirs) increases. Groundwater pollution is a far greater problem than the pollution of surface waters because groundwater pollution is frequently physically or economically irreversible.

Large scale development increases the percentage of impervious surfaces thereby reducing the amount of groundwater recharge. This comes at a time when the demand for water is increasing. For the quantity of groundwater to be seriously diminished the impervious surfaces would have to cover a significant portion of the recharge area. The only place in the State where this potential problem exists is in the New Castle County urbanizing area. The County is not blessed with significant water table aquifers and must rely on the Potomac formation for most of its groundwater, the recharge area of which is located in the path of future development.

Saltwater intrusion into aquifers is another problem associated with groundwater resources. The Atlantic Ocean, the Delaware Bay, the four inland bays (Rehoboth, Indian River, Little Assawoman and Assawoman) and the tidal estuaries draining to these bays all contain highly mineralized water. The Atlantic Ocean is in direct contact with the water table aquifer from Cape Henlopen to Fenwick Island. The inland bays, whose outlets are to the ocean and the tidal estuaries discharging into the bays, all overlie the water table aquifer.

The major saltwater problems of the area occur in the water table aquifer where the water table is five feet or less above sea level. In these areas there are a few localities in which freshwater cannot be obtained from the water table aquifer. In areas of low water table altitude where pumping has been heavy, trouble can be expected and has been encountered, especially at Lewes and Rehoboth Beach. Problems at both places have been alleviated by moving away from the area of contamination to an area of higher freshwater head in the aquifer. Saltwater contamination continues to be a problem on the resort end of Massey's Landing between Rehoboth and Indian River Bays. The combination of shallow on-site wells and septic tanks, highly permeable soils and the presence near the surface of saltwater results in highly contaminated water and presents a serious health hazard during the summer in many coastal areas.

State concerns relate to the public health aspects of safe, drinkable water, the availability of adequate supplies for fire protection, and ample supplies for industrial and other large non-domestic uses. Destruction of the aquifer recharge areas through paving or other developmental actions, and mismanagement of groundwater supplies through operation of poorly designed landfills, overutilization of available supplies, or permitting septic systems on highly permeable or high water table soils pose issues of grave importance.

Initial Planning Steps Taken

Identification of aquifer recharge areas is not a precise science; however, considerable effort has been expended under New Castle County's Planning and Water Quality Management Programs to identify recharge areas and develop management policies for them. In the rest of the State, it is necessary to

identify the areas where pollution of groundwater resources can occur due to soil permeability or the proximity of the water table to the surface.

Identification is also crucial regarding localized areas of groundwater quality or quantity. In this regard, the Water Resources Center at the University of Delaware prepared Technical Report Number 3 which includes both detailed surveys of the various aquifers and an evaluation of the State's groundwater resources. Management policies must adequately reflect this information to assure sufficient supplies of potable water and preclude developmental activities which damage the resources.

Areas of Geologic, Topographic or Morphologic Concern for Development

Significance

Certain resources are of vital concern to developers in the State's coastal areas. Among these are soils which are unstable and provide inadequate foundations for structures, utility systems or roadways. Many of the soils in this category are loose, noncompacted materials easily moved by wind or water. Examples include the beaches and coastal barriers and the soils which are highly erodible. Other areas are of concern because they are subject to slippage, as in the case of steep slopes, especially those with high clay contents, or those areas overlying geologic hazards which may experience major shifting or buckling movements.

Unstable soils subject to slippage, such as marsh muds, very sandy soils or high clay content soils, create problems of building load bearing capacity resulting in foundation cracking, or in extreme cases, building collapse. In such areas highway pavements are also subject to cracking and buckling as the unstable soils gives way beneath the highway traffic. Building excavation and land grading is difficult and costly in sandy or other highly unstable soils and requires shoring-up of excavation walls or other special measures to stabilize the soil.

In the Piedmont area of northern Delaware and along some stream banks, soil instability and erosion problems arise from steep slopes. Without adequate erosion prevention measures, clearance of vegetation from steep slopes can cause severe gully or sheet erosion, removing soil from the sloping surface and washing it into lower lands or streams.

In many parts of the Delaware coast, thick muds of the Holocene (geologically recent) era are highly unstable surfaces for any building development and are subject to severe subsidence and compaction. Ancient valleys and plains filled by these muds (up to seventy feet thick) occur at Port Mahon, South Bowers, the Mispillion River and the Great Marsh and Broadkill River north of Lewes, and other places. At South Bowers the highly unstable, rapidly eroding Holocene muds require extremely deep pilings (to 100 feet) to stabilize buildings.

While developmental risks in many of these areas are problems of the landowner and/or developer, the State has a genuine concern since eroded material may find its way into the coastal waters, clogging navigation

channels, damaging marine communities, and reducing the general quality of the waters. Construction on the coastal beaches or in areas underlain by unstable muds results in increased vulnerability to structural damage due to storm events or normal coastal processes, and necessitates greatly increased utility and highway construction and maintenance costs. Likewise, construction in fault zones raises the risk of serious property and public facility/utility damage, if not the potential for loss of life.

Initial Planning Steps Taken

Key research efforts during the development of the State's program were aimed at delineating the beaches and barriers, the thick subsurface muds, and any potential geologic hazards (Technical Reports Number 1 and Number 3 deal with these subjects in detail).

Steep slopes and highly erodible soils, other than the very erodible beach sands, are a problem primarily limited to the northern or piedmont portion of the State. Delineation of these areas was a major product of the New Castle County Water Quality Management Program.

The Coastal Waters and Subaqueous Lands

Significance

The waters of this State are perhaps its most widely used resource, providing an avenue for shipping, a home for a wide variety of fish and shellfish, a primary source of recreation, a dumping ground for disposal of wastes, the basis of many commerical and industrial enterprises, and the focus for a growing resort and second-home market. Each of these uses competes for the same limited resource, many with potentially detrimental effects on other uses and on the resource itself.

The submerged or subaqueous lands are also heavily used for the harvest of certain shellfish, the extraction of minerals, and as part of land development, navigation and waste disposal activities. As with the waters above these lands, improper use for any one purpose can prove detrimental to marine life, to the aesthetic quality of the waters, and to public health, safety and welfare.

State concern over these particular resources has been long standing as witnessed by the various State laws dealing with water pollution, use of submerged lands, and fish and shellfish resources.

The General Assembly, in establishing the Division of Environmental Control within the State Department of Natural Resources and Environmental Control, clearly established the State's concern over these resources and areas. As contained in Chapter 60 of Title 7, Delaware Code:

> "(a) Findings. -- The General Assembly hereby makes the following findings concerning the development, utilization, and control of the land, water, underwater and air resources of the State:

(1) The development, utilization, and control of the land, water, underwater and air resources of the State are vital to the people in order to assure adequate supplies for domestic, industrial, power, agricultural, recreational and other beneficial uses;

(2) The development and utilization of the land, water, underwater and air resources must be regulated to ensure that the land, water, underwater and air resources of the State are employed for beneficial uses and not wasted;

(3) The regulation of the development and utilization of the land, water, underwater and air resources of the State is essential to protect beneficial uses and to assure adequate resources for the future;

(4) The land, water, underwater and air resources of the State must be protected and conserved to assure continued availability for public recreational purposes and for the conservation of wildlife and aquatic life;

(5) The land, water, underwater and air resources of the State must be protected from pollution in the interest of the health and safety of the public;

(6) The land, water, underwater and air resources of the State can best be utilized, conserved, and protected if utilization thereof is restricted to beneficial uses and controlled by a state agency responsible for proper development and utilization of the land, water, underwater and air resources of the State;

(7) Planning for the development and utilization of the land, water, underwater, and air resources is essential in view of population growth and the expanding economic activity within the State.

(b) Policy. -- In view of the rapid growth of population, agriculture, industry, and other economic activities, the land, water and air resources of the State must be protected, conserved, and controlled to assure their reasonable and beneficial use in the interest of the people of the State. Therefore, it is the policy of this State that:

(1) The development, utilization, and control of all the land, water, underwater and air resources shall be directed to make the maximum contribution to the public benefit; and

(2) The State, in the exercise of its sovereign power, acting through the Department should control the development and use of the land, water, underwater and air resources of the State so as to effectuate full utilization, conservation, and protection of the water and air resources of the State.

(c) Purpose. -- It is the purpose of this chapter to effectuate State policy by providing for:

(1) A program for the management of the land, water, underwater and air resources of the State so directed as to make the maximum contribution to the interests of the people of this State;

(2) A program for the control of pollution of the land, water, underwater and air resources of the State to protect the public health, safety and welfare;

(3) A program for the protection and conservation of the land, water, underwater and air resources of the State, for public recreational purposes, and for the conservation of wildlife and aquatic life;

(4) A program for conducting and fostering research and development in order to encourage maximum utilization of the land, water, underwater and air resources of the State;

(5) A program for cooperating with federal, interstate, state, local governmental agencies and utilities in the development and utilization of land, water, underwater and air resources;

(6) A program for improved solid waste storage, collection, transportation, processing and disposal by providing that such activities may henceforth be conducted only in an environmentally acceptable manner pursuant to a permit obtained from the Department. (7 Delaware Code 1953, § Delaware Code 1953, § 6001; 59 Delaware Laws, Chapter 212, § 1.)"

The Act further provides as regards the State's submerged lands that pollution and contamination are prohibited.

"Avoidable pollution or avoidable contamination of the ocean and of the waters covering submerged lands, avoidable pollution or avoidable contamination of the beaches or land underlying the ocean or waters covering submerged lands, or any substantial impairment of and interference with the enjoyment and use thereof, including but not limited to bathing, boating, fishing, fish and wildlife production, and navigation shall be prohibited..."

Initial Planning Steps Taken

The State's coastal waters have been defined as part of the boundaries determination for this coastal zone management program. By State law, surface waters are defined as "water occurring generally on the surface of the earth", (Chapter 60, Title 7, Delaware Code) while submerged lands are defined as "lands lying below the line of mean low tide in the beds of all tidal waters within the boundaries of this State..." (Chapter 61, Title 7, Delaware Code). These definitions establish the areas of State concern and are adopted by reference for the purposes of this program.

WHERE TO FROM HERE?

This paper has dealt with the process of determining Geographical Areas of Particular Concern and has described the significance of the areas considered and the initial planning steps taken which will lead to eventual, specific designation.

An addendum to this working paper will specify areas recommended for designation, recommended techniques and policies for their most effective management and future needs and actions.

Your comments on this paper, its forthcoming addendum and subsequent working papers are most earnestly solicited. We would like to hear your ideas regarding the categories of areas discussed in this paper. Perhaps there are some we overlooked or, maybe you do not agree with those we suggest. In addition, we want your views as to how best these areas can be managed.